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ABSTRACT

A study was conducted at Stark Technical College to compare a normative-referenced test for mathematics placement with a criterion-referenced test that had been used by the college. The study sought to compare statistically the scores of 165 students on the Mathematics Inventory Test (MIT--a criterion-referenced test that had been developed locally to place entering students into the appropriate level of math) with their scores on the nationally administered Comparative Guidance and Placement (CGP) test. Study findings revealed: (1) students had very similar mean scores (20.5 on the MIT and 20.1 on the CGP) and median scores (19 and 20, respectively) on the two tests; (2) for students placed in Basic Tech Math, MIT and CGP scores were similar (MIT, 14.0; CGP, 15.4), as were the scores for students placed in Tech Math 1 (MIT, 30.6; CGP, 27.4); (3) the predictive validity of the normative-referenced test was significantly greater than that of the criterion-referenced test in predicting the grade point average of the students placed in Basic Tech Math and Tech Math 1. Study conclusions stress the advantages of normative testing for mathematics placement at the college. (HB)

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Criterion-Referenced vs. Normative-Referenced Mathematics Placement Test Comparison

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ABSTRACT

A normative-referenced test for mathematics placement was comparatively studied and found to have a high positive correlation (r=+.857) with the criterion-referenced test historically administered by the College in this study, and a moderate positive correlation (r=+.557) with first quarter grade point average.

Criterion-Referenced vs. Normative-Referenced Mathematics Placement Test Comparison

Background

Experience indicates that students enter college with considerably different achievement in mathematics. As a result, two different mathematics courses have been offered for students entering engineering technology programs at Stark Technical College: Basic Technical Mathematics, a course that deals with computation and elementary algebra, and Technical Mathematics I, the initial algebra course in all engineering technology programs.

Over a ten-year period, a locally developed criterion-referenced Mathematics Inventory Test was developed for placement of entering students into the appropriate level of math study for entering students. The exam included a sampling of mathematics questions from among the content of both Basic Technical Math and Technical Math I. Based on periodic review of the instrument and classroom performance of placement groups, it was established that students scoring 25 or below on the forty-item test would be required to take Basic Tech Math before entering Tech Math I. Those with inventory scores of 26 or greater were placed in Tech Math I upon entry to the College.

A major disadvantage of the inventory test was brought to the attention of the College by secondary education in the local service district: the locally developed criterion-referenced placement test would not permit the comparison of student

mathematics preparation with national norms for students entering other two-year colleges. With increased attention to inadequate preparation of high school students in both public and educational press, comparative feedback regarding student preparation in mathematics was important to the College.

To provide comparative feedback about the general quality of entering students in mathematics, a placement exam with national norms was encouraged. To accommodate this end, a placement exam review committee was established consisting of members from Stark Technical College and the Stark County School System. A number of norm-referenced exams were reviewed. The committee selected the Comparative Guidance and Placement Program (CGP) of the College Board. The Comparative Guidance and Placement Program has been designed to meet the counseling and placement needs of community colleges and technical institutes. CGP aids in accommodating differences among students in placement--adults, students weak in traditional academic areas, and students with various backgrounds, as well as students with appropriate academic preparation for college-level work (College Board, 1979).

Purpose of the Study and Methodology

Since the College was satisfied with the placement results of its math inventory, yet concerned about national achievement norms and comparative feedback to the service district, the two placement instruments required statistical comparison. The question that had to be answered primarily focused around an

internal notion by faculty that the norm-referenced test may not adequately place students into the criteria-specific courses in Basic Tech Math and Tech Math I.

Prior to admission, all new students were administered the criterion-referenced math inventory exam for placement purposes. During the first week of Fall Quarter, 1983, all Basic Tech Math and Tech Math I classes were additionally administered the norm-referenced CGP test in elementary algebra. Each student inventory and CGP score was recorded for analysis. Furthermore, the grade point average for each student was recorded at the end of the quarter. The data for 165 students was used in the comparative study which correlated the CGP test with the Mathematics Inventory Test and first quarter grade point averages.

Results

The Math Inventory and CGP test means, medians, modes, and standard deviations are compared in Table 1. The 20.5 and 20.1 test means differ only slightly. The median scores of 19 and 20 are remarkably similar. Based on test standard deviations, the CGP test scores were less variable. The STC Mathematics Inventory Test score distribution resulted in two distinct modes at 16 and 30, with these modes clearly separated by the 25-point cutoff established for differential placement of students in Basic Tech Math and Tech Math I. This bimodal distribution was closely replicated with the CGP Elementary Algebra Test score

distribution for the same group of students, with distinct modes at 12 and 29 clearly separated at a score of 25.

Table 1

Statistical Comparison of Math Inventory and CGP Elementary Algebra Test
N = 165

	Criterion-Referenced STC Mathematics Inventory Test	Normative-Referenced CGP Elementary Algebra Test
Mean	20.5	20.1
Median	19.0	20.0
Modes	16 and 30	12 and 29
Standard Deviation	9.3	7.6

In an effort to establish any relationship of Inventory and CGP test scores, Pearson's correlation coefficient between test scores was computed at r=+.857, which is a high positive correlation (Hinkle, 1979). Information related to this correlation and a regression equation are presented in Table 2.

Table 2

Relationship of Inventory and CGP Test Scores.
N = 165

Pearson's r = +.857; common variance r^2 = .734

Significance of correlation: $T = 21.3$, $df = 163$, $p < 10^{-6}$

regression equation: $Y = .694X + 5.85$

The Inventory and CGP test scores can be further broken down into two additional groupings: test scores for students placed in Basic Tech Math and test scores for students placed in Tech

Math I as presented in Table 3. Students placed in Basic Tech Math had similar average Inventory and CGP scores of 14.0 and 15.4, respectively. A similar result in average scores is apparent for students placed in Tech Math I, with average scores of 30.6 and 27.4.

Table 3

Placement Group
Inventory/CGP Test Score Comparison
N=165

	Group Inventory Score Average	Group CGP Score Average
Students placed in Basic Tech Math	$\bar{x}$ = 14.0 (SD = 5.2)	$\bar{x}$ = 15.4 (SD = 5.4)
Students placed in Tech Math I	$\bar{x}$ = 30.6 (SD = 3.5)	$\bar{x}$ = 27.4 (SD = 3.7)

The final phase of the study required the determination of the correlation coefficient between both the Mathematics Inventory Test and CGP Elementary Algebra Test with first quarter grade point averages of the subjects. These correlation coefficients were computed as r=+.446 and r=+.557, respectively, with related data presented in Table 4. By reviewing this data, it becomes evident that predictive validity was significantly greater ($p<.001$) using the normative-referenced test. Although the r=+.557 may seem lower than desirable, it must be kept in mind that the correlation coefficient would have been higher had placement not occurred.

Table 4

Correlation Comparison
Math Inventory and CGP Elementary Algebra Test
with first quarter GPA

STC Math Inventory	CGP Elementary Algebra
r=+.446	r=+.557
T=6.27 df=159	T=8.47 df=159
$p<10^{-6}$	$p<10^{-6}$

Summary

The use of a normative-referenced test was studied as a placement instrument for mathematics at Stark Technical College in lieu of the criterion-referenced test used in the past. The high positive correlation of the norm-referenced elementary algebra test of the CGP to the historically administered criterion-referenced inventory exam, the moderate positive correlation with first quarter grade point average, and the advantage of normative comparison in mathematics preparation all lend support to the suitability of the normative-referenced test for mathematics placement at the College in this study. It must be pointed out, however, that in no case should a single score on a placement instrument be used as the sole criterion in a placement decision. The key to the success of any placement program must be a good assessment of student achievement, which includes the consideration of placement test scores and at least data such as high school background (College Board, 1979).

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